

### **Proposed Technology-Greenfield WWTP, CO-OP Anaerobic Digester Pilot Test**

The City of Greenfield is purposing a pilot study of CO-OP Regional Anaerobic Digester that is co-owned by multiple towns, a unique answer to a local problem, possibly the only one of it's kind. There currently are no existing sludge disposal facilities in western Massachusetts that can service multiple wastewater plants and the possibility of new ones coming online seems remote at best. The towns interested in partnering in a CO-OP Digester at this time are S. Deerfield, Northfield, Sunderland and Montague. The cost saving for each town to dispose of their sludge for reduced or nonexistent tipping or trucking fee would be a huge economic relief while the environmental impact of reduction in trucking alone should be sizeable.

A feasibility study is to be conducted by Thomas Yeransian of Commonwealth Resource Management Company (CRMC). The goal of the study is to define the positive impact of a regional digester on possibly the environment and economy of the participant towns and the valley as a whole. Another aspect of the study will quantify the amount of bio gas that can be expected for use as heat and power for the facility. The power generated can be connected "behind the meter" to supply the treatment plant power resulting in our estimate a "net zero" operation. Mr. Yeransian in conjunction with Dr. Parks research will be used to model the design of the plant.

The second part of the study would be conducted by Dr. Chul Park of UMass Amherst. Dr. Park wants to conduct tests of seeding an anaerobic digester on a consistent basis with anaerobic bio-solids to show the retention time could be significantly reduced. This research, should it be successful, would reduce the size of the digester vessel(s), increase efficiency, lower the construction and operating costs for the facility netting additional savings.

In conclusion, it is our hypothesis that we can reduce carbon emission (see below), resource consumption, and efficiently use the funds of multiple communities to dispose of sludge in an efficient and environmentally responsible fashion. We all currently ship sludge to incinerators located mainly in the eastern portion of Massachusetts and RI, a method that is highly wasteful. Using trucks to haul sludge all over just to incinerate it, the sludge, is an unsustainable methodology. Our proposal reduces the trucking and use of carbon producing fossil fuels. Instead of using fuel to incinerate the sludge, we propose to use the sludge to produce the fuel to break down the solids and possibly generate some electricity to supplement the use electricity at other facilities. The reduction of trucking and incineration will also reduce carbon and particulate emissions further helping with air and water quality. While it is very difficult to quantify, it is no less important to consider the reduction of simple items such as the need to change tires less on the trucks, trucks and trailers will last longer, infrastructure will require less maintenance. All of these small pieces play in important role in the environmental and economic health of Massachusetts and its communities.

Greenfield WWTP is a biologic wastewater process facility. The current method of sludge disposal is by trucking 4-7 loads per week, 9000 gallons per load to Cranston, RI. In 2016 Greenfield trucked 144 shipments Cranston, RI. equaling 1,296,000 gallons of wastewater sludge with a solids content of approximately 5%. Each trip from Greenfield to Cranston is 108 miles (one way). The accepted weight per gallon of water is 8.34 pounds per gallon and in this case we would be hauling a load of 75,060 approximately. Using the calculator found at <http://www.freightemissionscalculator.com/> we produced 13759.468 Metric tons of CO<sub>2</sub>. If we were to reduce that shipping to 2-3 miles (a proposed secondary location of the digester) The CO<sub>2</sub> production drops to 382.207 Metric tons. That is a reduction in CO<sub>2</sub> production of 99 percent, a very large reduction. This represents a year in which almost all of our sludge was processed in Cranston RI. While this may be the extreme, it is in our best interest to develop a solution that avoids this scenario and offers a sustainable eco friendly method for sludge disposal.

I am unable to generate the same calculations for the other communities by the time I submit this document, however, it is feasible that the other communities will have similar savings in the percent of production but will not see as large a reduction in actual poundage of carbon produced.

**THW ATTACHMENT A – PROJECT PROPOSAL COVER SHEET**

<b>Project Title:</b>	Enter Project Title here
<b>Lead Applicant Name (as shown on your income tax return)</b>	Mark Holley
<b>Lead Applicant Business Name, if different than above</b>	Greenfield Wastewater Treatment Plant
<b>Lead Applicant Address (number, street, apt. or suite no., city, state, and ZIP)</b>	384 Deerfield St. Greenfield, Ma. 01301
<b>Lead Applicant Main Contact/s for the purpose of this Application (name, title, phone and email. Include address if different than above)</b>	Mark Holley, City of Greenfield, Superintendent of Water & Wastewater, 413-834-5080, <a href="mailto:mark.holley@greenfield-ma.gov">mark.holley@greenfield-ma.gov</a>
<b>Partner/s Applicant Name &amp; Address (number, street, apt. or suite no., city, state, and ZIP)</b>	Thomas Yeransian, 7 Winslow Way, Mansfield, Ma. 02048
<b>Partner Applicant Main Contact/s for the purpose of this Application (name, title, phone and email. Include address if different than above)</b>	Thomas Yeransian, Principal, 508-339-3074 <a href="mailto:tyeransian@crmcx.com">tyeransian@crmcx.com</a> Commonwealth Resource Management Corporation
<b>Brief Statement of project, partners, grant request, cost share and goals for use by CEC communications staff for Program publicity (no more than three sentences):</b>	The CO-OP Digester will be designed to service multiple communities. CRMC & UMass will collaborate on design of AD that best serves the needs of all communities involved. The money requested is for feasibility study and research the size of digester if anaerobic sludge is used to seed digester
<b>Total Cost of WWT Technology Pilot Project</b>	\$115,000.00
<b>Total Cost Share amount provided (cash/in-kind):</b>	\$33,700.00
<b>Total amount sought from MassCEC:</b>	\$78,000.00

ATTACHMENT B – PROJECT PROPOSAL APPLICATION FORM

**I. Project Summary**

*Provide a brief overview of the proposed WWT technology pilot project, including the goal of the project, how it*

*will help the technology advance its Technology and Commercial Readiness Levels, and save the WWT district or authority energy costs.*

The purposed project is a community owned Anaerobic Digester that will be shared by 4-6 towns with wastewater treatment plants within Franklin County. The main goal, reduction of expenditure of resources (fossil fuel etc.) and funds in the disposal of sludge from the area's Wastewater treatment plants through reduction of shipping costs and avoiding the incineration of solids, a unique approach with a regional solution in mind. A secondary goal, which is in alignment to the main goal, is to reduce the overall size of the digester and have redundant digester as back-up. Research will be conducted by UMass Dr.Chul Park on the effect of consistently seeding the digester with anaerobic sludge. The process should (theoretically) reduce the detention time required for complete anaerobic digestion and on the size of each AD tank. This should have a net effect of reducing resource consumption. The production of bio gas will be used to produce heat, and electricity in the hope that it will be at least self-sufficient.

*Provide a summary of the utility, facility, district or authority at which the demonstration project will be located. Why was the host WWT site selected?*

Greenfield WWTP will be the location of the research of anaerobic seeding of the digester. A nearby wastewater facility will supply the test with anaerobic sludge that will combine with Greenfield primary & WAS sludge. The reason for Greenfield WWTP location is because Greenfield will be supplying the majority of the sludge in a full scale Digester. There is a secondary location as a "plan B". UMass will set up lab scale digesters either on campus or Greenfield WWTP. Some lab analysis will be done at the university.

## **II. Potential of the Proposed Technology**

*Provide details regarding the water technology(ies) to be deployed, including (please address all of the following):*

A description of the water technology, including the current state and TRL of the technology as identified by the NYSEDA TRL Calculator. If the technology is commercial, please provide information and data showing where in the United States this technology is currently deployed and in use.

*Only technologies with a Technology Readiness Level of 8 and above will be considered under this RFP.*

Although much of the technology being used is not innovative, one aspect is. We will be consistently use anaerobic sludge to consistently seed the digester. It is our belief this will reduce the size of the digester and reduce the length time needed to digest solids. If we are to achieve both of these goals it would again reduce resources expended.

A description of how the technology is both innovative and viable. Including identification of innovative differentiating features vs. competitors or existing solutions.

Building a co-owned digester for a specific region is innovating idea and greatly needed. The difference from a standard anaerobic digester to the digester design we are considering with some proven research could be less retention time and smaller vessels.

Identification of the target market for the technology and relevant characteristics (regulatory landscape, trends, technology, market size), including the specific problem/opportunity the technology seeks

The overall problem for sludge disposal in our area is the skyrocketing costs and the resource intensive manner in which we dispose of sludge. The opportunity we seek is a one county sharing (co-owning) a digester. The technology we seek is a smaller anaerobic digester for use by multiple communities. To

to address.	reduce the carbon footprint associated with trucking sludge to out of state facilities to local travel.
An assessment of the technical risks associated with the technology, including the extent of identified risks and uncertainties, and proposed strategies for risk mitigation.	The technical risk is seeding an Anaerobic Digester to reduce retention time and vessel sizes. So the proposed strategy is the installation of a backup AD the same size for possible digester upsets, shut down for repairs and or a large unanticipated volume of sludge.
<b><i>Provide a description of how the technology can be commercialized, including (please address all of the following):</i></b>	
Project benefits in relevant metrics (e.g., customer/host productivity or revenue increases, new/retained job projections, etc.).	Less trucking(fuel consumption), digestion to produce bio-gas instead of fossil fuel consumption, reduction of stress on current sludge disposal facilities and a large reduction in air pollution, additional jobs to run AD, and cost avoidance to all involved towns.
An estimate of product cost (where applicable).	\$5 million to \$10 million dollars
How the WWT pilot project will move potential customers to choose the proposed solution.	Cost benefit to municipalities. Counties will build their own regional digester. Potential smaller digesters. Could, or should be, a model for many communities throughout the commonwealth and the nation.
The proposed go-to-market plan for the technology/solution. What is the first market Application? What is the size of the market and its growth trajectory? Do future market Applications exist?	Smaller more efficient Anaerobic digester, power generation, reduce cost to operate and build. A process that can be utilized throughout the industry.
The proposed business model of the company (i.e. will the product be licensed or sold directly to the end consumer?) If the business model will change over time (e.g. from a licensing to a manufacturing model), provide a description of this progression.	The idea is for multiple towns to be part owners of one anaerobic digester. Create a contract so each town agrees to its financial responsibility in the construction, operation and maintenance of the digester both long and short term. Create an overseeing board with a representative from each town.
<b>III. Project Benefits</b>	
<b><i>A detailed description of project benefits, including (please address all of the following):</i></b>	
The <b>benefits and potential impact of the proposed project to the Applicant Team</b> , including the water technology provider and the WWT district/authority (if applicable). How will the proposed WWT project help the Applicant Team achieve technology development and commercialization goals? Keep in mind energy efficiency is the number one criterion.	<p>Long term debt in financing a digester as sole source contributor.</p> <p>Short term debt if partnered in digester project. A significant reduction in operational cost to dispose of sludge off site. The research of seeding an anaerobic digester to help reduce retention time and digester vessel size is extremely important to whether a second digester vessel can also be built as back-up.</p> <p>Potential generation of electricity by methane gas.</p> <p>Distances from other towns to Greenfield WWTP:</p> <p>Montague WPCF to Greenfield 3miles vs 76 miles to Lowell</p> <p>Greenfield WWTP to Cranston,RI =109 miles</p> <p>S.Deerfield to Greenfield WWTP =8 miles</p>

	Sunderland to Greenfield WWTP =12 miles Northfield WWTP to Greenfield =20 miles
<b>Benefits to the Commonwealth:</b> A quantification of the estimated energy, climate, water quality improvement, and/or environmental benefits to the Commonwealth of Massachusetts (e.g., likely energy use reductions, projected GHG reduction, human health impacts, nutrient reduction or other measurable environmental benefits). A quantification of economic development impacts to the Commonwealth.	A regional digester will likely reduce electrical demand, fossil fuel consumption, and wear and tear to roads and associated infrastructure. The largest impact should be seen in the reduction of carbon and particulate emission from trucking and incineration.
<b>Benefits of deployment at scale:</b> The full estimated market potential for the technology when deployed under the proposed demonstration conditions. Quantify the energy and/or water quality, environmental, and climate benefits that are expected from the widespread adoption of the technology.	The potential will not be fully defined until this study is complete.
An explanation of the assumptions and methodology used to calculate the payback, if applicable.	Assuming the technology performs as planned, it will pay back the communities involved through cost avoidance, and improved air and water quality.
The plan for quantifying benefits after demonstration project completion.	Quantification of benefits will be calculated by comparison of disposal costs per gallon or pound.
Provide baseline energy use metrics and goals in terms of a percentage increase for one or more of the technology areas that is proposed for piloting, highlighting the participating WWTP facilities existing energy demand, and the percent change that should be expected through the proposed pilot.	It is hard to extrapolate the full impact on the host facility, it is our theory that it will be energy neutral or slightly positive to the host community.
Propose energy use improvement project performance targets.	
Provide baseline metrics for secondary benefits such as resource recovery and nutrient remediation.	
<b>IV. Applicant Team Statement of Qualifications</b>	
Describe the proposed relationships that will support a technically and economically successful project, including the relevant skills, credentials and experiences of key Applicant Team members. All responses should specifically	

<i>indicate the Applicant Team's current and historical expertise in conducting a WWT pilot as requested by this RFP.</i>	
Identify the Lead Applicant and their role. Identify the point of contact who will serve as the project manager. For each individual, note their relevant skills, credentials and experiences.	<b>Mark Holley</b> Greenfield Superintendent, Project manager & administrator of project will provide information and direction to engineers and research partners.
Identify all other members of the Applicant Team and their roles. For each individual, note their relevant skills, credentials and experiences.	<p><b>Thomas Yeransian:</b> Principal of CRMC Inc., Chemical Engineer. Design engineer/owner of Anaerobic Digesters.</p> <p><b>Dr.Chul Park:</b> UMass Amherst Research Professor, Extensive research into sludge reduction projects. Will research anaerobic seeding of a digester.</p>
V. Budget Narrative	
<i>Include a budget narrative that provides additional detail on <u>each budget line item included in the Project Work plan and Budget Template (Attachment C).</u> Keep in mind the required cost-share of <b>at least 50% (in-kind and cash) of the total grant request.</b></i>	
The larger portions of the budget will be divided between the work at UMASS and the work of Commonwealth Resource Management Corp. Task one will include the coordination, scheduling, and resource allocation of the project funds and final report. Task two will include the laboratory research of Dr. Park at UMASS and completion of the final laboratory report. Task three is the culmination of the laboratory results, energy analysis of the co op that will be used to produce a final engineering report. This will be used to develop the RFP for construction of digester facility.	

**It is the sole responsibility of the applicant to ensure that their Application is complete and properly submitted.**

#### **ATTACHMENT C – PROJECT WORK PLAN AND BUDGET TEMPLATE**

Fill in the below proposed project work plan and budget template based on the WWT Technology pilot project that is being proposed. Add/Delete additional rows as needed. In order to evaluate the overall budget at the time of the Application, please specify staff time, expected expenses and detailed calculations for each milestone, including but not limited to, any use of third parties, expected purchases of data and/or market intelligence, and design and printing when creating the budget for the proposed Work Plan. This will form the basis for the negotiated contract scope for selected projects. **It is expected that the selected Applicant Team will be paid on a milestone achieved and deliverable provided basis.** If selected, this proposed project plan may be modified by MassCEC.

Upon completion of the Task, the achieved Milestones should support the Deliverable provided. Ensure that each task and milestone is clear and broken down thoroughly as to avoid the Applicant Team requesting payment for partially completed milestones.

*MassCEC Water Innovation Program - Request For Proposals  
Wastewater Treatment Plant- Innovative Technology Pilots: FY2018-WIP-WWTP-ITPI*

Deliverable – A tangible object produced as a result of the completion of the Task. Each Deliverable should be directly related to a Task or Milestone. The invoice for the Task will be paid based on MassCEC's receipt and approval of the Task's Deliverable.

- A deliverable must have some component that may be subject to a public records request.
- Unless otherwise noted in the contract, invoices shall be paid upon the receipt of a deliverable.

Milestones/Deliverables to MassCEC	Completion Date	Estimated Budget	Grantee Cost Share amount	MassCEC Payment Amount
<b>Task 1: e.g. Kick-off meeting</b>				
• Scheduling of deliverables w/partners	6/18	\$5,000	\$1,650	\$3,350
• Assigning Deliverable Responsibilities	6/18	\$5,000	\$1,650	\$3,350
Final Report	2/19	\$5,000	\$1,650	\$3,350
<b>Task 2: <u>Anaerobic Seeding Research</u></b>				
UMass set-up research lab @ Greenfield WWTP	2/18	\$25,000	\$8,000	\$17,000
• Research the Effect of a Constant Seeding an Anaerobic Digester	11/18	\$30,000	\$10,000	\$20,000
• UMass provides Final Report	3/19	\$10,000	\$3,500	\$6,500
<b>Task 3: <u>Anaerobic Digester Feasibility Study</u></b>				
Compiling of all data provided by CO-OP Partners, sludge analysis, amount being treated and digester waste	2/19	\$10,000	\$3,500	\$6,500
• Energy Analysis of CO-OP Anaerobic Digester (e.i. trucking, Electric generation, composting)	3/19	\$10,000	\$3,500	\$6,500



*MassCEC Water Innovation Program - Request For Proposals  
Wastewater Treatment Plant- Innovative Technology Pilots: FY2018-WIP-WWTP-ITPI*

• Final Engineering Design Report		4/19	\$10,000	\$3,500	\$6,500
<b>Total</b>			<b>\$110,000</b>	<b>\$33,700</b>	<b>\$78,000</b>

*\*For evaluation purposes only and will not be included in final executed contract*

# CommonWealth

Resource Management Corporation

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Thomas Yeransian, Principal

With over thirty years of professional experience as a project developer and consultant, Mr. Yeransian manages the development, licensing, engineering and operation of facilities and projects primarily in the fields of solid waste management, combustion, and power generation. Areas of expertise include:

**Development of solid waste management facilities, combustion facilities, anaerobic digestion facilities and renewable power generation facilities** from the initial market assessment and feasibility analysis through site selection, design, procurement, construction, start-up and operation of facilities.

**Environmental permitting management** to produce environmental impact reports, and to apply for and acquire permits necessary for facility construction and operation.

**Creation, registration and trading of emissions reduction credits** including criteria pollutants to meet emissions offset requirements and greenhouse gases to meet emerging international requirements.

**Process systems engineering** to establish performance and design characteristics in support of permitting, process modifications, and competitive business and market evaluation.

**Emissions control technologies engineering** to evaluate technical and economic performance of alternative emissions controls, and to specify system modifications, all as required for permitting or compliance with environmental standards or regulations.

**Business and economic analysis** in support of investment decisions and feasibility assessments of environmental facilities, programs, and services, including landfills, waste-to-energy, landfill gas utilization, anaerobic digesters, materials recovery facilities, and renewable resource power generation projects and enterprises.

As a principal and a founder of CommonWealth, Mr. Yeransian has specialized in screening project opportunities, projecting biogas quantities; preparing project concepts and designs; assessing the commercial viability of technologies; negotiating project agreements; and specifying and optimizing equipment to collect and utilize landfill gas and anaerobic digester biogas in projects developed by CommonWealth. In addition, Mr. Yeransian has managed the acquisition of environmental permits and approvals for more than 20 landfill gas recovery projects, as well as for numerous solid waste landfills, waste-to-energy facilities, renewable energy facilities, independent power production facilities and industrial facilities.

Prior to joining Commonwealth in 1991, Mr. Yeransian, was a senior consultant at a national firm specializing in the development of waste-to-energy facilities, where he prepared and negotiated facility conceptual designs and technical specifications; acquired environmental permits; and supported project construction and acceptance testing efforts. Mr. Yeransian had previously been an environmental consultant for ENSR, in which position he acquired environmental permits and supported the development of a broad range of industrial facilities. Mr. Yeransian has bachelors' degrees in chemical engineering and economics from Tufts University and a master's degree in business administration from Boston College.

## **Enhancing coop anaerobic digestion using sludge from the anaerobic side-stream reactor (ASSR) process**

Chul Park

Department of Civil and Environmental Engineering; University of Massachusetts Amherst

### **Background and Rationale**

Conventional anaerobic digestion (AD) typically requires 20-30 days of digestion time at mesophilic conditions (37 °C) to support slow-growing anaerobic microbial community. This slow process is also required for hydrolysis and degradation of sludge feedstock, especially for the waste activated sludge (WAS) that degrades more slowly with greater limit of digestibility compared to raw sewage sludge (i.e., primary sludge). Consequently, conventional AD systems need to have large-size reactors that can accommodate long digestion retention time.

AD based on a short retention time can, therefore, decrease the size and footprint of the system, which is an important factor for facilities that consider the adoption of AD systems. Likewise, a shorter retention time for existing AD systems allows digestion of larger quantity of feedstock, which can lead to greater production of bioenergy and related revenues.

The retention time of AD can be decreased if the digestion temperature is increased (e.g., thermophilic conditions at 55°C). The digestion time can also be potentially decreased if pretreatment of feedstock (i.e., enhancing hydrolysis) is employed. Numerous pretreatment technologies are available in the field. However, it is not difficult to find that the results of the application of these methods in the field are highly variable. Furthermore, it can be quickly realized that both thermophilic digestion and pretreatment-based digestion enhancement will require substantial amount of energy and associated carbon footprint to achieve the goal.

We have several communities that are interested in installing and operating coop AD to digest sludge produced from their wastewater treatment plants (WWTPs). Why this is important for this region? Why this is so exciting and innovative idea? This is currently not a practice in Western MA or anywhere else possibly, and this has the possibility reduce the expenditure of multiple resources!

This innovative approach can even be more innovative if we can accomplish successful and stable AD with a significantly reduced retention time (i.e., smaller system). We hypothesize that this approach is possible because sludge from one WWTP in the community contains a large population of anaerobic microbes and, thus, feeding this sludge continues to provide anaerobic “seed”, which can boost up the AD process. This way of operation can also continue to provide diverse but key anaerobic microorganisms into the system, which is expected to contribute to increasing the stability of the AD process. Indeed this stability is very important because it is well known that AD is sensitive to variety of factors and once the system gets upset, it takes tremendous time and efforts to recover the system.

Montague WWTP has been operating the anaerobic side-stream reactor (ASSR) process for their wastewater treatment and this method has enabled them to significantly decrease the production of sludge. The process basically depends on very long retention time of sludge within the system where sludge is recirculated between aerobic and anaerobic environments. The result is the

establishment of both strict aerobic microbes (such as nitrifying bacteria) and anaerobic organisms (e.g., methanogens) within one sludge biomass. When sludge is located in the main aeration basin, it degrades incoming sewage organics and nutrients, growing into easily settling flocs. When sludge is moved into the anaerobic reactor, hydrolysis and degradation of sludge happens anaerobically. Since the retention time of this anaerobic reactor is very short (<3 d), partially undegraded materials will be completely utilized when sludge is sent back to the aerobic basin. Overall, this approach produces minimal amount of waste sludge while continuing to perform effective wastewater treatment.

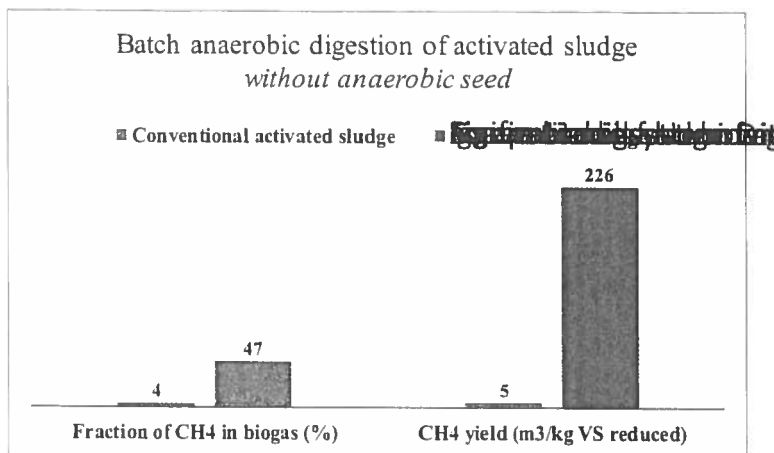
The preliminary data (Figure 1) supports our hypothesis that sludge from this ASSR system (whether from the aeration basin or the ASSR tank) can be used as continuous seed to the coop AD. Figure 1 shows the methane ( $\text{CH}_4$ ) production from the batch anaerobic digestion of two activated sludges (from aeration basins); one from the conventional activated sludge (CAS) system and the other from the ASSR system. Important to note is that these activated sludges were digested anaerobically without the addition of any anaerobic seed biomass. As

expected, CAS sludge without seed did not digest well and produce any meaningful  $\text{CH}_4$  even after 14 days of digestion. However, digestion of activated sludge from the ASSR system produced significant amount of  $\text{CH}_4$  despite the absence of the anaerobic seed. These preliminary results support the idea that sludge in the ASSR system, even from its aeration basin, already contains large population of key AD microbial community.

The primary sludge and WAS do not contain significant population of methanogens (methane-producing microorganisms). Furthermore, typical organic wastes for AD, such as food waste, have little methanogens within them. Consequently, typical AD requires sufficiently long retention time. However, our approach will allow the addition of feed sludge which already contains significant population of anaerobic microorganisms. Hence, it not only boosts up the AD process (Figure 1) but also continuously provides anaerobic seeds into the AD system.

### Plan of pilot work

UMass Amherst team, led by Prof. Chul Park in the Department of Civil and Environmental Engineering, will work closely with the Greenfield and Montague WWTPs as well as other community municipalities that will participate in this coop AD project.



To investigate the feasibility of the accelerated AD by addition of the ASSR sludge among the sludge feedstock, the UMass team will conduct pilot AD research. It is expected that sludge from Greenfield WWTP will comprise up to xx % of feed to this coop AD so we will focus digestion of this sludge with the addition of ASSR sludge for this pilot project.

The pilot research will include the operation of one experimental AD (i.e., the addition of ASSR sludge) and the control AD (i.e., no ASSR sludge in feed). During the first phase of this pilot (~three months), we will operate these two ADs under typical digestion conditions employed at WWTPs (i.e., 20 d retention times; 37 °C). During this phase, we will characterize physicochemical characteristics of digested sludge as well as several operational parameters that are used to assess the stability of the system. Obviously, production and composition of biogas will be routinely determined. After this phase, we will move to the main research phase (remaining 9 months) by decreasing the retention time of both experimental and control ADs, first to 15 days and later to 10 days of retention time. Evaluation of the system performance and stability will be determined as the first phase of pilot.

The pilot AD will be operated in the Department of Civil and Environmental Engineering laboratory at University of Massachusetts Amherst. UMass is located within 20 min driving from both Montague and Greenfield WWTPs so that we can collect feed sludge to ADs from both facilities almost in daily basis. The laboratory also has a state-of-art temperature-controlled room (37 °C), approximately 80 ft<sup>2</sup> with two working benches, a sink with tap water, and several power outlets. These laboratory resources as well as proximity of UMass to municipalities participating in this project will substantially facilitate the current coop AD project.

Dr. Park and his team are committed to updating and sharing the data and findings regularly to the whole project participants as well as MassDEP. They are also committed to presenting and submitting the interim and final reports to MassCEC.

### **Budget**

The UMass team requests \$65,000 for this one-year pilot AD demonstration.

# CommonWealth

Resource Management Corporation

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George Aronson, Principal

Mr. Aronson has more than 30 years of progressively responsible experience supporting the development and operation of capital projects, facilities and programs as an analyst, consultant and project manager, with a broad record of accomplishment in the fields of solid waste management, alternative electricity production, and resource recovery and utilization. His areas of expertise include

**Business and economic analysis** in support of investment decisions and feasibility assessments of environmental facilities, programs, and services, including waste-to-energy, landfill gas utilization, and materials recovery facilities, and renewable resource power generation projects and enterprises.

**Procurement of facilities and services** on behalf of public sector sponsors and agencies, including identification and structuring of business ownership and financing arrangements; preparation of procurement documents; proposal evaluation; and support of vendor selection and service contract negotiations.

**Implementation of plans for integrated resource management**, including design of waste reduction strategies and development of material and waste processing, transportation and residuals management arrangements.

**Development of power supply arrangements**, including resource availability and energy market assessments, contract negotiations, interconnection studies and acquisition of environmental permits and related regulatory approvals.

As the chief financial officer and a founder of CRMC, Mr. Aronson routinely performs and presents detailed pro forma financial analyses of proposed and operating programs and facilities, and assessments of resource market characteristics, business development approaches and financing strategies.

Prior to joining CRMC, Mr. Aronson was a senior consultant at a national firm specializing in the development of waste-to-energy facilities for public sector clients, where he directed procurement of full service contractors, prepared feasibility studies, supported negotiation of power purchase agreements and provided support for tax-exempt bond financing of privately-owned facilities. Mr. Aronson had previously been a staff analyst and then the technical director of the Massachusetts Energy Facilities Siting Council, a state regulatory agency that reviewed applications to construct electric generation and transmission facilities.

Mr. Aronson has a bachelor's degree in mechanical engineering from the Massachusetts Institute of Technology and a master of public policy degree from the John F. Kennedy School at Harvard University. He is a member of the Northeast Commerce and Energy Association, the Solid Waste Association of North America, Massachusetts Chapter, and the MIT Enterprise Forum.

# CommonWealth

Resource Management Corporation

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15:57

Donald Ouellette, P.E.  
Director of Public Works  
Town of Greenfield  
14 Court Square  
Greenfield, MA 01301

RE: Proposal to assess the feasibility of developing an anaerobic digestion project at the Town of Greenfield Waste Water Treatment Facility as a cooperative project serving 5 to 7 local waste water treatment plants

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Dear Mr. Ouellette,

CommonWealth Resource Management Corporation (CRMC) is pleased to provide this proposal to assist the Town of Greenfield (herein the "Client") in cooperation with the Town of Montague in assessing the feasibility of developing a moderately sized anaerobic digestion project at the Greenfield Waste Water Treatment Plant. The project would accept and process sludge that is generated from multiple waste water treatment facilities located in several communities in the region including the Towns of Greenfield, Montague, Deerfield, South Deerfield, Sunderland, Hatfield and Northfield. The Towns of Greenfield and Montague have obtained preliminary interest from these communities to cooperate in the development and use of the project.

CRMC understands that the Client and surrounding communities are concerned with (1) rising costs of transportation and disposal of sludge generated from their waste water treatment plants (WWTPs), and (2) more restrictive requirements and limited capacity for accepting sludge at the sludge disposal facilities serving the New England region. The Client is interested in addressing these concerns by hosting a cooperative anaerobic digestion project with the primary objective of aggregating sludge from the region to obtain an economically viable scale and then to reduce the sludge volume that may require disposal. Generating the bulk of the sludge requiring disposal in the area, the project would be located at and integrated to the Greenfield Wastewater Treatment Plant. Spent digestate from the project would be transported via truck 2.4 miles to the Montague Wastewater Treatment Plant for solids separation through an existing belt filter press system. The separated sludge solids would be either composted for land application or disposed. The separated water would be returned to the headworks of Montague or Greenfield WWTPs.

The communities, which may participate in this cooperative anaerobic digester project, generate an average of 387,000 gallons per month or 13,000 gallons per day of combined primary and secondary sludge at 3 to 5-percent solids content as follows:

Community	Average 9,000 gallon	Average wet sludge
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	truck loads per month	generated, gallons per month
Greenfield	16	144,000
Montague	12	108,000
Deerfield	2	18,000
South Deerfield	4	36,000
Sunderland	5	45,000
Hatfield and Northfield	4	36,000
Total	43	387,000

The Client is interested in determining the feasibility of developing an anaerobic digestion facility to be located at available space within site of the Greenfield WWTP, and integrate its operation with the existing operations of the WWTP. The goal would be to reduce the quantity of sludge required for disposal, and generate biogas for use at the WWTP. The Client has also been working with Dr. Chul Park, Associate Professor at the Department of Civil and Environmental Engineering at University of Massachusetts Amherst to research and pilot test the cycling of wastewater solids through a high-rate anaerobic side stream reactor to accelerate the anaerobic digestion of sludge. Some preliminary level of research and testing of this acceleration of sludge decomposition has been conducted at the Montague WWTP. The Client proposes to engage Dr. Park to further conduct testing at UMass and possibly at the Montague WWTP. The test results would provide a basis and the inputs for CRMC to assess the impact of this innovative technology approach on the sizing, performance and economics of an AD project as part of the feasibility assessment. The Client is seeking grant funding from the Massachusetts Clean Energy Center (MassCEC) to further the pilot research and development of the acceleration concepts explored at the Montague WWTP as well as fund the CRMC feasibility assessment as an integral part of the pilot test program.

If the assessment determines that a cooperative anaerobic digester project is feasible, the model may be replicated in other moderate- and low- densely populated areas to meet the needs of such communities to manage the sludge output from their respective waste water treatment plants.

The remainder of this letter describes the tasks, deliverables, schedule and budget that CRMC proposes.

CRMC proposes the following tasks.

***Task 1      Obtain relevant information from Client***

Objective:      Obtain relevant information from Client as a basis to perform feasibility analysis.

Tasks:          CRMC would perform the following tasks:

- Prepare information and data request for Client review.
- Such information would include

- the maximum and average sludge generation quantities and solids and volatile solids content for all potential participating WWTPs.
  - daily and monthly sludge data that shows the peak and low point production points for all potential participating WWTPs
  - storage capacity for sludge at each WWTP
  - projections of anticipated growth of sludge generation from all potential participating WWTPs.
  - electricity and thermal usage rate for past two years
  - existing site plans showing the site layout, process flows and mass balances of the Greenfield WWTP.
  - design and actual performance data for the Greenfield WWTP and Montague dewatering system
  - delineation of the alternative site areas contemplated by the Client for locating the project, and points of integration with existing facilities.
  - the existing site plans, process flows and mass balances of the dewatering system at the Montague WWTP and ancillary support systems including sludge feedstock storage, separated solid and water storage further processing and disposition.
  - information on the Montague composting operation and compost end-use
  - identify transport vehicles to be used for moving sludge, spent digestate and compost.
- Define influent stream limitations and issues for accepting the wastewater stream from the dewatering of the spent digestate
  - Conduct site visits of both the Greenfield and Montague WWTP, and other sites as identified by Client for siting the project.
  - Confer with Dr. Chul Park to obtain papers and other descriptive information that provides the status of his research, testing and pilot program that is relevant to the feasibility assessment. Obtain specific test results that can be used to assess the impact of the innovations on the conceptual design sizing, design and performance tasks.
  - Confer with Dr. Park, Mr. Bob McDonald and staff to determine the extent of the pilot test results at the Montague WWTP.

## ***Task 2      Conceptual design and performance of the anaerobic digestion system***

**Objective:** Define the conceptual design and performance of the anaerobic digestion system to process the sludge generated by the WWTP to meet the objectives of the Client

**Tasks:** CRMC would perform the following tasks:

- Confer with Client to identify the Client objectives (e.g. volume reduction of sludge, biogas utilization, digestate use)
- Size the anaerobic digestion system for the sludge generated by the WWTPs using conventional design and performance metrics

- Size the anaerobic digestion system for the sludge generated by the WWTPs using accelerated digestion and higher conversion rates based on implementing innovations from results of research and testing by Dr. Park and Montague WWTP
- Provide alternative conceptual designs based upon single versus double anaerobic digesters
- Confer with Client on existing site area to place and support an anaerobic digestion system. Confer with Client on existing WWTP infrastructure to support and integrate an anaerobic digestion system with the existing WWTP equipment and systems. Define feedstock and spent digestate storage and flow of materials into and out of the anaerobic digestion system and existing WWTP
- Describe basic process at the Greenfield and Montague WWTPs.
- Use CRMC experience at CRMC Bioenergy Facility to prepare alternative mass balances, process flow diagrams and conceptual design figures and performance tables.
- Describe key process components and operations that would comprise the conceptual design level project and its integration to existing Greenfield and Montague WWTPs.
- Prepare a conceptual block level layout of the project configured on the available site or sites identified by Client.

### ***Task 3      Project Economics***

**Objective:**      Assess the economics of the anaerobic digestion system to determine if a project could be commercially feasible.

**Tasks:**          CRMC would perform the following tasks:

- Estimate capital costs based upon CRMC experience developing and installing the CRMC Bioenergy Facility
- Confer with Client on operations of the anaerobic digestion system as an integral component of the WWTP to estimate operating costs.
- Confer with Client regarding current and projected costs of sludge disposal.
- Prepare an economic pro forma that shows the capital cost build-up, revenues, operating expenses, cash flows without depreciation and tax effects, and avoided costs to determine simple payback and return on investment. Sensitivities will be assessed for the alternative project sizes due to test results from Dr. Park research and pilot program.
- Prepare description of results and basis for the results.

**Task 4      Deliverable:** CRMC will prepare a letter report that consolidates and summarizes the results of Tasks 1, 2 and 3.

### ***Proposed Budget***

CRMC proposes to perform the tasks as described above when and to the extent authorized and directed by Client and subject to not-to-exceed budget limits consistent with the described scopes of work and the budget limits set forth below. Work would be performed on a time-and-materials basis in accordance with our standard consulting agreement. Fees for CRMC's services would be invoiced monthly based on (1) hours charged to the project at our standard rate of \$210 per hour; and (2) charges for reimbursement of out-of-pocket expenses reasonably incurred by CRMC in the performance of the services, such as travel and automobile expense, express postage and shipping charges, and extraordinary copying and production costs.

The budgetary costs for CRMC to perform the tasks described above are as follows:

<i>Task</i>	<i>Description</i>	<i>Hours</i>	<i>Labor costs</i>	<i>Other costs</i>	<i>Total costs</i>
1	Obtain relevant information from Client	20	4,200.00		4,200.00
2	Conceptual design and performance of the anaerobic digestion system	40	8,400.00		8,400.00
3	Project Economics	40	8,400.00	-	8,400.00
4	Deliverable	20	4,200.00		4,200.00
	Reimbursable expense allowance	3.0%		756.00	756.00
Total Cost					25,956.00

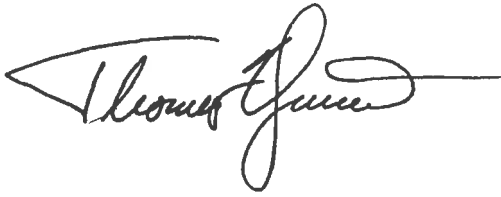
CRMC will neither perform nor invoice for services beyond the authorized budget without prior approval from Client. It is understood that actual costs will depend upon a variety of factors, including the extent to which information is readily available, and timely and complete performance by Client of its responsibilities identified in Task 1 and 2, and unforeseen circumstances that become evident during the development of the project. CRMC reserves the right to exceed budgetary limits on individual authorized tasks or line-items as long as the overall authorized budget is not exceeded, and Client is kept informed of the progress on each task.

### ***Proposed schedule***

CRMC is prepared to begin to provide services upon your authorization. After Client authorization and the timely receipt of the necessary information by or on behalf of Client, CRMC projects that the work can be completed within eight-weeks.

If this proposal is acceptable, please confirm your acceptance by countersigning this proposal letter. Please feel free to call me with questions at (508) 339-3074. Thank you for considering CRMC.

Sincerely,

A handwritten signature in black ink, appearing to read "Thomas Yeransian", with a long horizontal flourish extending to the right.

Thomas Yeransian  
Principal

---

Accepted

Date

Copy:

Robert McDonald, WWTP Chief Operator



Commonwealth of Massachusetts  
Executive Office of Energy & Environmental Affairs

## Department of Environmental Protection

Western Regional Office • 436 Dwight Street, Springfield MA 01103 • 413-784-1100

Charles D. Baker  
Governor

Karyn E. Polito  
Lieutenant Governor

Matthew A. Beaton  
Secretary

Martin Suuberg  
Commissioner

### MEETING REGISTER

Subject: Franklin Cty AD Proposal

Date: 2/7/18

Attendee

Representing

Telephone #

Email Address

Don Charlotte

Greenfield

578 302 4276

Mark Holley

Greenfield

413-834-5080

mark.holley@greenfield-ma.gov

Bob McDonald

Montague

413-773-8865

ROBERT MC MONTAGUE-MA.GOV

Catherine Skiba

MassDEP

413-755-2119

CATHERINE.SKIBA@STATE.MA.US

Brian Hornum

MassDEP

413-755-2291

Brian.D.Hornum@STATE.MA.US

Mac Sigaen

MassDEP

413-755-2115

Mac Sigaen @ state.ma.us

Dave Hornum

MassDEP

413-755-2280

David.hornum@state.ma.us

Dan Kuepaka

Mass DEP

413-755-2274

DANIEL.J.KUEPAKA@STATE.MA.US

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This information is available in alternate format. Contact Michelle Waters-Ekanem, Director of Diversity/Civil Rights at 617-292-5751.

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# Anerobic Digester Journal

Event	Date	Comments
1st Joint meeting	11/7/2017	Friendly Greenfield
Site visit Clinton /Dartmouth	11/30/2017	Informative
Turner's Selectmen Meeting	12/11/2017	Positive reception
Deerfield Counsel Meeting		Positive reception
Sunderland Selectmen Meeting	11/27/2017	Positive reception
DEP meeting Dan Kurpaska/Paul Neitupski		Very receptive
Bob Dean FRCOG	12/26/2017	Assistance for inter municipal agreement 413-774-3167 ext 108
USDA Jennifer Sharro	1/10/2018	413-923-3243 Grant/loan discussion
EPA Angela Page	1/11/2018	202-564-7957
EPA Micheal SSWR Grants	1/11/2018	202-564-4453 202 329 9249 <a href="http://www.epa.gov/sbir">www.epa.gov/sbir</a>
Keith Barnicle/Congressmen Mcgovern	1/24/2018	413-341-8700
2nd Joint meeting	2/1/2018	Friendly Grrenfield
DEP meeting	2/7/2018	Dave Howland Special Projects DEP Brian Harrington Pre permitting Dan Kurpaska Paul Neitupski

Heritage  
Historical

NP68 Waste Water Alteration

DOER

Site Assignment  
Board of Health  
MEPA - stop-